Understanding the Role of Meibomian Gland Dysfunction in Dry Eyes

The International Dry Eye Workshop separated dry eyes into two main categories in 2007.

Aqueous Deficient Dry Eyes as defined by an inability to produce sufficient tears. Aqueous deficient dry eyes can be further separated into two main categories Sjogrens Syndrome and non Sjogren’s Syndrome.

1) Sjogren’s syndrome Dry Eyes
   a. Primary: Due as a standalone condition
   b. Secondary: As a result of another autoimmune condition.

2) Non-Sjogren’s dry eye etiology:
   a. Lacrimal Deficiency
   b. Lacrimal Gland Duct Obstruction
   c. Reflex Block – (i.e. refractive corneal surgery)
   d. Systemic Drugs – (Antihistamines, hypertensive medications)

Evaporative Deficiency Dry Eyes as defined by an over evaporation of tears and are categorized as Intrinsic or Extrinsic factors:

1) Intrinsic:
   a. Meibomian gland oil deficiency (Meibomian gland deficiency)
   b. Disorders of the lid aperture (lagophthalmos, incomplete blink, floppy eyelid syndrome)
   c. Low Blink Rate (environmental computer usage)
   d. Drug Action of Accutane

2) Extrinsic:
   a. Vitamin A Deficiency
   b. Topical Preservative Drug (i.e. chronic glaucoma medications)
   c. Contact Lens Wear
   d. Ocular Surface Disease (i.e. Allergy, Blepharitis)

Most recently only 10% of dry eyes was determined to be solely due to an aqueous deficiency disease and that 80% of dry eyes was due to a purely evaporative or mixed evaporative/deficiency disease with MGD accounting the majority of the evaporative component.

Dry eye disease can be best described as positive feedback loop. Tear film instability and imbalance can lead to evaporation which can result in tear hyperosmolarity. Due to the increased hypertonic environment, the conjunctival and corneal cells can be damaged leading to cellular death. Cellular death results in neuronal activation of inflammatory mechanisms to aid in the healing process which can lead to an increase in cytokine and MMP-9 levels and eventual goblet cell death that can further exacerbate the tear film stability. A review by Badouin et al. summarized the following cycle of dry eyes nicely in the diagram below. The internal circle describes the tear film stability, while the outside circle discusses the factors that can directly affect the tear film stability at different cycle points.
The Arrangement of the Meibomian Glands:

1) There are approximately 25-40 Meibomian glands in the upper lid with an average length of 5.5mm and a median of 31 glands
2) There are approximately 20-30 Meibomian glands of the lower eyelid with an average length of 2mm and a median of 26 glands
The histologic appearance of the Meibomian Glands is as follows:

The Acinus produce cells filled with Meibum that mature and migrate towards the center of the Acinus.

As the cells mature, they lose all their organelles and are just lipid filled sacs that burst and drain into the ductal system leading to the central duct and are released to the tear film through the excretory duct.
**Mechanism of expression:**
Mechanical contraction of M. Orbicularis muscle during blink milks the glands towards external epidermis with relaxation of marginal muscle of Riolan leading to the expression.

Active glands in only 45% of gland openings at one time. Treatment of Meibomian Gland Dysfunction or atrophy to increase efficiency of remaining glands will still be beneficial to address symptoms.

There is a decrease of active glands by 50% between age 20 to 80. This is likely due to hormonal changes and environmental changes.

**Importance of blinking:**
With increased computer usage, blinking needs to be discussed in patient education. Normal blink rate is about 15 blinks per minute with a decreased blink rate to about 5 blinks per minute when reading or working on the computer.

**Reasons for Dysfunction:**
Meibomian gland dysfunction occurs when hormonal or environmental triggers cause epithelialization of the excretory duct. This means that the epidermis from the external eyelid migrates towards the conjunctiva of the inner eye causing a plug to form in the excretory duct. When this plug forms, it results in increased pressure that backs up into the central duct, then the ductules and eventually leads to hypertrophy, of the acinus and eventual death. Since the acinus is continually producing meibum, if there is no place for it to go, eventually the internal pressure becomes so great that the cells have no place to release the meibum and eventually lead to cell death.
Another source of blockage can occur if there is a change in the Meibum consistency increasing the viscosity and leading to obstruction as well. Changes in the meibum quality can lead to an imbalance on the lid margin and increased bacterial growth that breaks down the lipids releasing pro-inflammatory factors that can lead to atrophy of the acini. Aging and contact lenses can also have a direct impact on the Meibomian Glands.

**Grading Meibomian Gland Dysfunction:**

![Meiboscale and Area of Loss](image-url)
Grading of Meibomian Gland Dysfunction can be described by a Heiko-Pult grading scale regarding atrophy. Atrophy of glands should be graded on a scale of 0-4 based on the atrophy seen.

**Width of Meibomian Gland:**

While no current studies have described the width of the Meibomian glands, we would recommend describing the gland width as, tortuous and hypertrophied. It is our belief that Hypertrophied glands may be due to keratinization of the lid margins and require an exfoliation process. Tortuous vessels may point towards increased internal viscosity resulting in uneven pressure distribution and a shift in the lay out of the Meibomian glands. Atrophy of the glands can indicate a potential intrinsic factor that may benefit from transdermal testosterone therapy.

![Narrow, Tortuosity, Hypertrophied](image)

**Composition:**

The viscosity of the Meibomian Glands should be described on a scale of 0-3 based on descriptions below.

<table>
<thead>
<tr>
<th>Expressed Meibum</th>
</tr>
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<tbody>
<tr>
<td>0 = Clear</td>
</tr>
<tr>
<td>1 = Cloudy</td>
</tr>
<tr>
<td>2 = Cloudy; particulate</td>
</tr>
<tr>
<td>3 = Toothpaste</td>
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**How to bill for Meibography Imaging:**

Meibography for the usage of documenting meibomian gland dysfunction currently is a non-covered service and is unlikely to be covered in the future. The CPT code for Meibography is 03220T. There are reports in the optometric community that Meibography imaging has been billed as a 92285 CPT code for a reimbursement of $21.85. However, based on the reimbursements and the vague rules regarding the billing, we would recommend just providing patients with an ABN and charging a $40-$60 fee.


While some providers are concerned about the pushback regarding the out of pocket costs to patients, performing Meibography can save a patient thousands of dollars in medication costs. Information obtained by imaging the Meibomian glands will aid the doctor in determining a course of treatment that may save a patient thousands of dollars in medication costs.